Synthetic Seismic Wave Propagation through thermal Mantle Plumes

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The imaging of Mantle Plumes has been mainly carried out using seismic ray tomography. However, it turns out that due to wavefront healing and other finite frequency effects results from tomography may lead to underestimates of the perturbations of seismic velocities and the density caused by plumes. This points out the need for complete wavefield modeling. Therefore, in this study we consider a model resulting from a three-dimensional numerical plume experiment (Goes &Hansen, EGS - AGU - EUG Joint Assembly, 2003, Session GD6). The plume is a purely thermal with depth dependent expansivity, conductivity and temperature- and depth dependent viscosity. Using this model together with an appropriate earth model (ak135) we carry out forward modeling of the three-dimensional wavefield for SH-waves. Calculations are done with a hybrid Finite Difference code (Jahnke et al., EGS 2002) that combines a axisymetric FD scheme for global wave propagation with a spherical 3D-FD scheme for the plume and the receiver region where the seismograms are recorded. This way we are able to achieve reasonably high frequencies with a limited computational effort and high accuracy. We show the wavefield and seismograms with and without the presence of the plume and compare the results with those from observational studies.